national accelerator laboratory

FN-266
2100

NUCLEAR EMULSION - STREAMER CHAMBER METHOD FOR TAGGING HADRONIC INTERACTIONS WITH NUCLEI AND SEARCHING FOR CHARMED PARTICLE DECAYS

L.Voyvodic
Fermi National Accelerator Laboratory

October 24, 1974

Spark chamber tagging of tracks in nuclear emulsion has previously been used in cosmic ray studies[1] and is under development for accelerator neutrino experiments.[2],[3] The same basic technique can also be applied to accelerator hadronic interactions in emulsions.

We consider here the use of emulsion mini-stacks as target regions between small event-triggered streamer chamber modules. Secondary particle distributions and vertex predictions are obtained from conventional film reconstruction techniques with the streamer photographs, and the analysis of each interaction is augmented by detailed microscopic examination of the interaction vertex region in the emulsion. In particular, the method is well suited for systematic search for charmed particle production and decays, as recently discussed by Gaillard et al.[4] Both charged and neutral decay modes of varying topologies could be analyzed by this method if the charmed particle lifetimes are in fact in the range $10^{-15} \lesssim \tau \lesssim 10^{-11}$ seconds.

Operated by Universities Research Association Inc. Under Contract with the United States Atomic Energy Commission

Figure 1 shows a simple portable streamer chamber previously used for studying track formation in gaseous hydrogen[5], which can serve as a prototype for the emulsion chamber proposed here. With a simple mini-stack arrangement of 50 Ilford K5 emulsion pellicles (each 0.6 mm wide, 2 cm thick in the beam direction and 10 cm high), an exposure to ~25,000 protons at 400 GeV would result in ~2,500 analyzable interactions whose full tagging information would be contained on one standard roll of 35 mm streamer chamber film. The mean spacing of interacting beam tracks would be about 1,000 microns, which should allow unambiguous correlations if the streamer chamber reconstruction accuracy is $\lesssim$200 microns (within one field of view under typical emulsion scanning conditions).

Exposures yielding $\sim 10^4$ analyzable events in four such mini-stacks could be carried out in several shifts of either slow spill or bubble chamber pinged beams. The use of beam track Cerenkov identifying markers in each streamer chamber photograph would allow full exploitation of Fermilab's secondary and enriched beams of high energy $(p,\bar{p})$, (π^+,π^-) and possibly (K^+,K^-) particles. Muon exposures could also be considered for heavy lepton searches. Auxiliary tagging information from downstream detectors could also be signalled on the streamer chamber photographs; e.g., the presence of high transverse momentum particles detected in a suitable calorimeter.

REFERENCES

1. R.L.Kinzer et al, Nuc. Inst & Methods 76,70 (1969) and references therein.
2. E.H.S.Burhop et al, Nuovo Cimento 39, 1097 (1965).
3. E.H.S.Burhop, Fermilab Proposal 247 (1973).
4. M.K.Gaillard, B.W.Lee and J.L.Rosner, Fermilab PUB-74/86-THY.
5. L.Voyvodic, S.Prunster and W.A.Williams, Bulletin Washington APS Meeting (1970).